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SOME COMMENTS ON GAS MIXTURES USED IN MULTIWIRE ION CHAMBERS AND MULTIWIRE PROPORTIONAL CHAMBERS

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There have been some questions about the gases used in multi-wire ion and proportional chambers. The questions concern possible damage to the chamber by the decomposition of the gases in the ionization processes. This technical memorandum is to provide some information to the users on the subject.

Since the early 1940's there have been studies to determine the cause of the deterioration of Geiger-Müller counters and multiwire ionization and proportional chanbers. The studies showed that polymers of composition CH_2, ethane, ethylene, and acetylene are formed during the ionization process in gas mixtures containing methane (CH_4).[1] In general, there is found H_2, saturated and unsaturated hydrocarbons in the solid or liquid form on the cathode and anode wire surfaces. The hydrocarbons form a light brown insulating film on the electrodes.

I have observed this polymerization with 10% CH_4 and 90% Argon gas mixture filled proportional counters and chambers. After a total of 10^9 to 10^{10} pulses/wire cm the detector became unusable. This number corresponds approximately to a total number of electron-ion pairs of 10^{16} to 10^{17}. The only practical way for recovering the

detector was to replace the contaminated wires. The same effect has been found with argon-isobutane and argon-propane gas mixtures.[2]

The insulating film formed on the wires causes variations in the gas gain factor along the wires depending upon the beam rate per unit length. The first reaction of the user to this effect is to gradually increase the high voltage applied to the detector. A very probable result of this is a breakdown discharge which could cause the breakage of a wire.

We recommend that one may use a helium gas or argon gas mixed with a small amount of CO_2 (pure argon gas is metastable) in the ion chambers and 20% CO_2 + 80% Argon gas mixtures in the proportional chambers unless higher gas gain is required. Some probable contamination may occur using this gas mixture due to impurities. With up to 10^{12} pulses/wire cm we have not observed any deterioration in the performance of our proportional wire chambers. This is in good agreement with the results obtained elsewhere indicating that up to a total number of 10^{13} pulses there was no appreciable effect on the performance of the proportional counters.[3]

REFERENCES

[1] E. C. Farmer and S. C. Brown, Phys. Rev. 74, 902 (1948).

[2] E. Bloom, K. Duty, G. Johnson, H. Piel, and S. Siemann, SLAC-IN-70-5.

[3] Private communications, LND Co., Long Island, New York.